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Case Study

NEW APPROACH IN RAIN WATER HARVESTING THROUGH ROOFTOP WATER MANAGEMENT TECHNIQUE- CASE STUDY

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Abstract- Rooftop rainwater harvesting is a simple but effective method to harvest rainwater. Over exploitation and limited recharge of groundwater is causing a negative draft of water below the soil surface. The water level and the quality of water is deteriorating due to less dilution. Rooftop rainwater harvesting produces an alternate method for domestic use of water. A study was conducted in a household located at Marjita village of Tirtol block in Jagatsinghpur district, Odisha, which lies between 20^{0}20' 54"N latitude and 86^{0}22' 9" E longitude. The Geographical area of Jagatsinghpur district is 1668 Km^2 and the annual average rainfall is 1436 mm. The gross groundwater draft for domestic and industrial water supply was estimated as 339.57 ha-m. The rooftop rain water harvesting was able to meet the 80 % of the total water required in that household on daily basis.

Keywords- Negative draft, Overexploitation, Recharge, Water harvesting

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Introduction

Climate change is the major concern for any country in the world, which is directly affecting the human beings. Water is the most necessary requirement for survival of any living being. Rainfall is the key climatic variable. Climate change is causing the disturbance in hydrologic cycle and we are experiencing the negative impact of it. As a result, some part of the world is experiencing flood while other parts are experiencing drought at the same time. Due to over exploitation and less recharge of ground water, there is a negative draft groundwater is observed, due to which water table is lowering day by day. Now time has come to think about the conservation and replenishment of this precious natural resource, *i.e*., water. There is a saying that "good work should begin from home". Small steps in conservation of water will not only fulfil our daily needs but also contribute in recharging groundwater. In this context, roof top rain water harvesting is an emerging and cost-effective technology, which not only save the rain water going as waste but also to use them for domestic consumption. The roof tops of the buildings recharged through specially designed recharge pits met almost 80% of domestic water requirements of for Hyderabad city [1]. The potential of potable water saving in a house might vary from 30% to 60%, depending on the demand and roof area [2]. The potential water saving by using water harvesting in 62 cities ranged from 34% to 92%, with an average potential for potable saving of 69% [3]. 27 houses in Newcastle were analysed and concluded that rainwater usage would promote potable water saving of 60% [4]. Efficient management of water resources and education about judicious utilisation of water resources along with measures of harnessing, recharging and maintaining the quality of water and water bodies are the need of the day [5]. During last three decades rainfall trend is decreasing (Negative) in Shrirampur, Parner, Shrigonda, Karjat, Jamkhedand Nagar tehsils whereas last four years Ahmednagar district is facing drought due to scanty rainfall [6]. For water saving by using rainwater harvesting [7] evaluated the amount of rainwater harvesting potential was 78.44% of the total ground water demand of R.B.N.B. College Campus, Shrirampur. The selected household located at Marjita village of Tirtol block in Jagatsinghpur district, Odisha, which lies between 20^{0}20' 54"N latitude and 86^{0}22' 9" E longitude.

Study Area

The selected household was located at Marjita village of Tirtol block in Jagatsinghpur district, Odisha. The area lies between 20^{0}20' 54"N latitude and 86^{0}22' 9" E longitude. The area receives average annual rainfall of 1436 mm but due to sea water intrusion and excessive iron content in the water, the ground water available is of poor quality. Therefore, to decrease the dependency on ground water and to utilize the rain water, roof top rain water harvesting method was considered. The study makes an attempt to estimate the quantity of rain water harvested and to enable them to be used for consumption in that household.

Methodology

Data Collection

The rain water harvesting technique is used on primary data as well as secondary data, primary data regarding the building and roof top area were surveyed from field study and secondary data specially rainfall data was collected from the meteorological stations and various published and unpublished books, articles etc.

Calculation of Co-efficient of Runoff

Runoff coefficient for any catchment defined as the volume of Runoff generated from a given rainfall to the volume of rainfall received. Runoff coefficients account for losses that occur due to evaporation, infiltration, catchment wetting, spillage and leaking, which will contribute to reducing the runoff.

$$\text{Coefficient of Runoff (Cr)} = \frac{\text{Volume of Runoff}}{\text{Volume of Rainfall on that surface}}$$

Therefore, in present study the co-efficient of runoff is taken as 0.8 for rooftop due to impervious surface and 0.4 for surface land area.

Table-1 *Monthly average rainfall data of Jagatsinghpur district from 1990 to 2010*

Months	Rainfall(mm)	Months	Rainfall(mm)
Jan	0.6	July	167.57
Feb	0.3	Aug	193.76
Mar	0.2	Sep	126.75
Apr	3.02	Oct	40.18
May	20.54	Nov	0.3
June	108.70	Dec	0.4
Total -662.32mm			

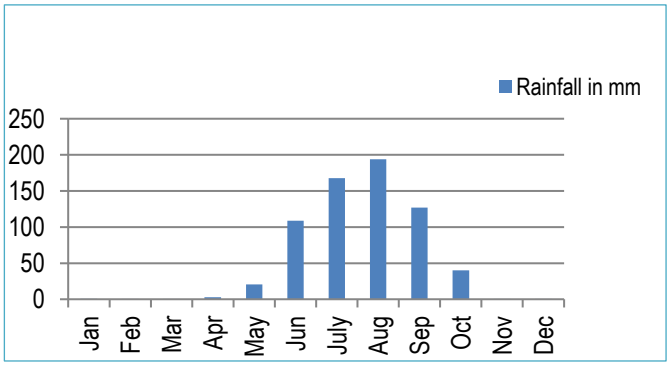

Fig-1 Monthly Rainfall at Jagatsinghpur District

Hydrological analysis

The Rainwater harvesting potentiality can be calculated as follows:

$$P = R \times A \times Cr$$

Where,
P= Potentiality of Rain water harvesting (M^3)
R= Mean annual rainfall (mm)
A = Catchment area (M^2)
Cr =Coefficient of Runoff

Results and Discussions

The Rainfall data was collected from the meteorological stations and the roof top of building was measured with a metric tape. The total rooftop area of the house hold has been calculated as 280 m^2. The total no. of persons staying in that household was 6. Rain water harvesting potential was calculated by applying Gould [8] formula. Potentiality of rain water harvesting is found out by multiplying average annual rainfall with catchment area and runoff coefficient. The amount of water harvested from the rooftop was found to be 148.32 m^3, by taking average annual rainfall as 662.32 mm and coefficient of runoff as 0.80. The water collected from the rooftop can be stored in a sump, which can be used for the consumption in that household and for watering the plants.

Estimation of Annual Water demand

The total water demand for that household is about 185400 litres, out of that 5400 litres of water is used for drinking purpose considering 3 litres of water per person per day (As per C.P.C.B standard for rural areas), while 180000 litres of water required for other use with 100 litres per person per day.

Sl No.	No. of users	Water Demand (litres)		Total water demand (litres)
		Drinking	Others	
1	6	6 x 3 x 300=5400	6 x 100 x 300= 180000	185400

The rooftop water harvesting system provided 148.32 m^3 *i.e.*, 148320 litres of water for the household and 20% of water *i.e.*, 37080 litres of water are available from the water supply system of district authority. The rooftop rain water harvesting system along with supply water will fulfil the water requirement of the household. Besides that, poor quality water available from the borewell can be used for cleaning the vehicle and other purposes.

Conclusion

The present study has focused on the issue regarding availability quality water for household consumption and reduction of scarcity using roof top rain water harvesting technique. The rain water harvesting is one of the cost-effective measure to overcome the problems faced due to water scarcity. This approach computes the harvesting potential of rainwater based upon the catchment area characteristics. The quantity of water available from the catchment therefore depends upon the annual average rainfall, catchment area characteristics and extent of catchment area. The water demand can be assessed by working out the catchment area water supply and the actual demand of water. The study has quantified that the rain water harvesting structure provides 80% of the total annual requirement of the household. Hence, if this project is implemented then the problem due to water scarcity and quality of water will be solved. The salty water available from the bore well may be used for cleaning and other purposes.

Application of research: The research will be helpful to provide an alternate way for the water scarcity problem in rural areas and to meet the daily water requirement of households. It will also act as an alternative method for recharge of groundwater table in the coastal area of Odisha.

Research Category: Efficient and judicious use of rain water for domestic and ground water recharge purpose.

Abbreviations:
L: Litres; M^3: Cubic meter; Km^2: Square kilometre; Ha: Hectare; mm: millimetre; %: percent

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